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August 02, 2004

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OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT  
APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A  
FILING DATE.

APPLICATION NUMBER: 60/458,227

FILING DATE: *March 27, 2003*

RELATED PCT APPLICATION NUMBER: PCT/US04/09358

By Authority of the  
COMMISSIONER OF PATENTS AND TRADEMARKS

*M. Tarver*

M. TARVER  
Certifying Officer



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03/27/03



3-28-3  
60456227-A/PROV  
PTO/SB/16 (10-01)  
Approved for use through 10/31/2002. OMB 0651-0032  
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

## PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No. EV036313487US

J0996 U 158227 PTO  
03/27/03J0996 U 158227 PTO  
03/27/03

### INVENTOR(S)

Given Name (first and middle [if any]) Thomas J. Jeremiah U.	Family Name or Surname Webster Ejiofor	Residence (City and either State or Foreign Country) West Lafayette, IN West Lafayette, IN
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Additional inventors are being named on the \_\_\_\_\_ separately numbered sheets attached hereto

**TITLE OF THE INVENTION (500 characters max)**  
TITANIUM AND TITANIUM ALLOY NANOPARTICLES AS ORTHOPEDIC BIOMATERIAL

Direct all correspondence to:

### CORRESPONDENCE ADDRESS

<input checked="" type="checkbox"/> Customer Number 23643	<input type="checkbox"/> Customer Number Bar Code & type here 23643
OR Type Customer Number here	PATENT TRADEMARK OFFICE

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### ENCLOSED APPLICATION PARTS (check all that apply)

<input checked="" type="checkbox"/> Specification Number of Pages 5	<input type="checkbox"/> CD(s), Number
<input type="checkbox"/> Drawing(s) Number of Sheets	
<input type="checkbox"/> Application Data Sheet. See 37 CFR 1.76	<input checked="" type="checkbox"/> Other (specify) Postcard

### METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

<input checked="" type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27.	FILING FEE AMOUNT (\$) 10-0435 \$80.00
<input checked="" type="checkbox"/> A check or money order is enclosed to cover the filing fees	
<input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number	
<input type="checkbox"/> Payment by credit card. Form PTO-2038 is attached.	

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

No.  
 Yes, the name of the U.S. Government agency and the Government contract number are: National Science Foundation, Grant/Contract Title:

Respectfully submitted,

SIGNATURE

Date 3/27/03

TYPED or PRINTED NAME Bradford G. Addison  
TELEPHONE (317) 231-7253

REGISTRATION NO. 41,486  
(if appropriate)  
Docket Number: 3220-72619

### USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. The information is used by the public to file (and by the PTO to process) a provisional application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the complete provisional application to the PTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, D.C. 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Box Provisional Application, Assistant Commissioner for Patents, Washington, D.C.



11 South Meridian Street  
Indianapolis, IN 46204  
(317) 236-1313  
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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

<i>Group:</i>	Unknown	}
<i>Confirmation No.:</i>	Unknown	
<i>Application No.:</i>	Unknown	
<i>Invention:</i>	TITANIUM AND TITANIUM ALLOY NANOPARTICLES AS ORTHOPEDIC BIOMATERIAL	}
<i>Applicant:</i>	Thomas J. Webster et al.	
<i>Filed:</i>	Herewith (March 27, 2003)	
<i>Attorney</i> <i>Docket:</i>	3220-72619	
<i>Examiner:</i>	Unknown	}

**CERTIFICATE UNDER 37 C.F.R. § 1.10**

BOX Provisional Patent Application  
Commissioner for Patents  
Washington, D.C. 20231

Sir:

I hereby certify that this correspondence is being deposited with the United States Postal Service as Express Mail, in an envelope addressed to the Commissioner for Patents, Washington, D.C. 20231, on March 27, 2003. The Express Mail mailing label number is EV036313487US.

Respectfully submitted,

BARNES & THORNBURG

  
Karla I. Mays

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# **FEE TRANSMITTAL for FY 2003**

Effective 01/01/2003. Patent fees are subject to annual revision.

Applicant claims small entity status. See 37 CFR 1.27

**TOTAL AMOUNT OF PAYMENT** (\$) **\$80.00**

**Complete if Known**

Application Number	Unknown
Filing Date	Herewith (March 27, 2003)
First Named Inventor	Thomas J. Webster et al.
Examiner Name	Unknown
Group Art Unit	Unknown
Attorney Docket No.	3220-72619

**METHOD OF PAYMENT** (check all that apply)

<input checked="" type="checkbox"/> Check	<input type="checkbox"/> Credit card	<input type="checkbox"/> Money Order	<input type="checkbox"/> Other	<input type="checkbox"/> None
<input type="checkbox"/> Deposit Account:				
Deposit Account Number	10-0435			
Deposit Account Name	BARNES & THORNBURG			

**The Commissioner is authorized to: (check all that apply)**

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 Charge any additional fee(s) ~~plus the filing fee~~  
 Charge fee(s) indicated below, except for the filing fee  
to the above-identified deposit account.

## **FEES CALCULATION (continued)**

3. ADDITIONAL FEES		Large Entity		Small Entity		Fee Description
Fee Code	Fee (\$)	Fee Code	Fee (\$)	Fee Code	Fee (\$)	
1051	130	2051	65	Surcharge - late filing fee or oath		
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet		
1053	130	1053	130	Non - English specification		
1812	2,520	1812	2,520	For filing a request for ex parte reexamination		
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action		
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action		
1251	110	2251	55	Extension for reply within first month		
1252	410	2252	205	Extension for reply within second month		
1253	930	2253	465	Extension for reply within third month		
1254	1,450	2254	725	Extension for reply within fourth month		
1255	1,970	2255	985	Extension for reply within fifth month		
1401	320	2401	160	Notice of Appeal		
1402	320	2402	160	Filing a brief in support of an appeal		
1403	280	2403	140	Request for oral hearing		
1451	1,510	1451	1,510	Petition to institute a public use proceeding		
1452	110	2452	55	Petition to revive - unavoidable		
1453	1,300	2453	650	Petition to revive - unintentional		
1501	1,300	2501	650	Utility issue fee (or reissue)		
1502	470	2502	235	Design issue fee		
1503	630	2503	315	Plant issue fee		
1460	130	1460	130	Petitions to the Commissioner		
1807	50	1807	50	Processing fee under 37 CFR § 1.17(q)		
1808	180	1808	180	Submission of Information Disclosure Statement		
8021	40	8021	40	Recording each patent assignment per property (times number of properties)		
1809	750	2809	375	Filing a submission after final rejection (37 CFR § 1.129(a))		
1810	750	2810	375	For each additional invention to be examined (37 CFR § 1.129(b))		
1801	750	2801	375	Request for Continued Examination (RCE)		
1802	900	1802	900	Request for expedited examination of patent application		

## **2. EXTRA CLAIM FEES FOR UTILITY AND**

	Extra Claims		Fee from below		Fee Paid
Total Claims	<input type="text"/>	-20** =	<input type="text"/> 0	$\times$	<input type="text"/> 0.00
Independent Claims	<input type="text"/>	- 3** =	<input type="text"/> 0	$\times$	<input type="text"/> 0.00
Multiple Dependent					

### Large Entity | Small Entity

				Fee Description
Fee Code	Fee (\$)	Fee Code	Fee (\$)	
1202	18	2202	9	Claims in excess of 20
1201	84	2201	42	Independent claims in excess of 3
1203	280	2203	140	Multiple dependent claim, if not paid
1204	84	2204	42	** Reissue independent claims over original patent
1205	18	2205	9	** Reissue claims in excess of 20 and over original patent

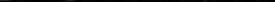
**SUBTOTAL (2) (\$)** **\$0.00**

\*Produced by Basic Filing, Inc. Reid

**SUBTOTAL (3)**

(5)

**Complete (If applicable)**

SUBMITTED BY		Complete (if applicable)		
Name (Print/Type)	Bradford G. Addison	Registration No. (Attorney/Agent)	41,486	Telephone (317) 231-7253
Signature			Date	3/27/03

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60453227, D52712  
EXPRESS MAIL NO.: EV036313487US

PROVISIONAL PATENT APPLICATION

of

Thomas J. Webster  
(West Lafayette, IN)

and

Jeremiah U. Ejiofor  
(West Lafayette, IN)

for

TITANIUM AND TITANIUM ALLOY NANOPARTICLES  
AS ORTHOPEDIC BIOMATERIAL

PRF Docket No. P-03032.P1

Attorney Docket 3220-72619

## TITANIUM AND TITANIUM ALLOY NANOPARTICLES AS ORTHOPEDIC BIOMATERIAL

### FIELD OF THE DISCLOSURE

The present disclosure generally relates to a composition for use as a prosthetic biomaterial and an associated method. The present disclosure particularly relates to a prosthetic biomaterial that includes titanium and titanium alloy nanoparticles and an associated method.

### BACKGROUND OF THE DISCLOSURE

Biomaterials commonly used in orthopedic prosthetic applications are not designed to retain functionality while maintaining compatibility with respect to biological factors at the implant/tissue interface. In order to achieve proper cytocompatibility, it is desirable to determine the biomaterial surface characteristics that interface optimally with the pertinent bone cell types. Achieving similar mechanical properties to native tissue ensures limited destruction of local cells. Surface texture is also important to control for orthopedic implant efficacy to closely harmonize with the mass and kinetics of osseous biomolecular events.

### DETAILED DESCRIPTION OF THE DISCLOSURE

While the disclosure is susceptible to various modifications and alternative forms, specific embodiments will herein be described in detail. It should be understood, however, that there is no intent to limit the disclosure to the particular forms described, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the disclosure.

The current disclosure involves the use of nanoparticles of Ti and Ti alloy (specifically, Ti6Al4V) as more effective bone tissue biomaterials. Nanoparticulates (size range: less than 200 nm) have high surface reactivity. In their properly consolidated conditions, nanoparticles result in increased elastic modulus and strength as well as in nanostructured grains. Material formulations developed in our laboratory contain highly nanostructured crystal grains

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fabricated out of their corresponding nanoparticles, and possess properties (cytocompatibility and mechanical) that are appropriate for different orthopedic applications in the skeletal system. Most importantly, the designed nanophase titanium and its alloy significantly increase functions of cells that are responsible for bone cell adhesion and bone tissue regeneration. Significantly increased adhesion and differentiation of bone cells as well as mineralization of the tissue are desirable to result in efficient and effective implant function. For these reasons, nanoparticles of Ti and Ti6Al4V are desirable (as they very closely match the mass and kinetics of bone/bodily fluid biomolecular reactions and enhance osseous functions) for the next generation of orthopedic prosthetic implants.

In particular, constructs of Ti and Ti6Al4V nanoparticles in their green or consolidated conditions and possessing nano grain size and/or nano porosity simulate the nanometer dimensions of components of the bone tissue and body molecules. Formulations of Powder Metallurgy Titanium and Titanium Alloy from their nanoparticles possess enhanced surface and mechanical properties to increase performance of bone fixation and total bone replacements. Nanometer dimensions of the Ti and Ti6Al4V grains and the nanoscale, equidispersed morphology of their surfaces, optimize both surface and mechanical requirements. These nanophase formulations significantly promote sustained bone cell adhesion and differentiation, a major requirement to efficient integration of implant with juxtaposed tissues. Current Ti and Ti6Al4V implants materials frequently fail to maintain long-term biointegration with the body tissue, quickly leading to failures at the interface. In contrast, nanoparticles of these metals simulate the nano dimensions of cellular molecules, promoting bone cell adhesion, proliferation and long term functions that sustain implant-bone interface integrity. Accordingly, an orthopedic prosthetic device which includes nanoparticles of these metals can be utilized in a method for implanting such a device in the body of an animal.

While the disclosure has been illustrated and described in detail in the foregoing description, such an illustration and description is to be considered as exemplary and not restrictive in character, it being understood that only the illustrative embodiments have been

described and that all changes and modifications that come within the spirit of the disclosure are desired to be protected.

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ABSTRACT OF THE DISCLOSURE

A composition for use as a prosthetic biomaterial and an associated method is described.